Interactive Ray-Tracing
Siggraph Course 13

Course Notes for Siggraph 2001
Los Angeles, California
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Course Organizer

Philipp Slusallek

Speakers

Steven Parker
Hanspeter Pfister
Timothy Purcell
Erik Reinhard
Philipp Slusallek

Course Summary

The term ray-tracing is commonly associated with highly realistic images but certainly not with interactive graphics. However, with the increasing hardware resources of today, interactive ray-tracing is becoming a reality and offers a number of benefits over the traditional rasterization pipeline. Interactive ray-tracing has the potential to change the future of interactive graphics as we know it today.

This course presents cutting-edge research activities exploring interactive ray-tracing as an alternative to traditional triangle rasterization. Speakers will discuss advantages and challenges of interactive ray-tracing, present implementations on systems from PCs to supercomputers, and introduce new ideas for ray-tracing hardware.

The course will help participants to better understand the benefits and challenges of using ray-tracing in an interactive context. It is a unique opportunity for Siggraph attendees to get an overview of the state-of-the-art and compare different approaches taken to make interactive ray-tracing a reality.

A large part of the material presented in this course has been prepared based on recent results from ongoing research projects and has not been published before.

Speakers

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Steven Parker is a Research Assistant Professor in the Department of Computer Science at the University of Utah. His research focuses on problem solving environments, which tie together scientific computing, scientific visualization, and computer graphics. He was a recipient of the Computational Science Graduate Fellowship from the Department of Energy. He received a Ph.D. from the University of Utah in 1999, and B.S. in Electrical Engineering from the University of Oklahoma in 1992.

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Hanspeter Pfister is a Research Scientist at MERL - A Mitsubishi Electric Research Laboratory in Cambridge, MA. He is the chief architect of VolumePro, Mitsubishi Electric's real-time volume rendering system for PC-class computers. His research interests include computer graphics, scientific visualization, computer architecture, and VLSI design. Hanspeter Pfister received his PhD in Computer Science in 1996 from the State University of New York at Stony Brook. In his doctoral research he developed Cube-4, a scalable architecture for real-time volume rendering. He received his

Dipl.-Ing. degree in electrical engineering from the Department of Electrical Engineering at the Swiss Federal Institute of Technology (ETH) Zurich in 1991. He is a member of the ACM, IEEE, the IEEE Computer Society, and the Eurographics Association.

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Tim Purcell is a third year Ph.D. student in the department of Computer Science at Stanford University. His research focuses on architectural design for hardware ray tracing. He was a recipient of the Graduate Research Fellowship from the National Science Foundation. He received a B.S. in Computer Science from the University of Utah in 1998.

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Erik Reinhard is a researcher at the University of Utah in the fields of parallel ray tracing and visual perception. He received a 'TWAIO' diploma in parallel computer graphics from Delft University of Technology in 1996 and a PhD degree from the University of Bristol in 2000. His current research interests include algorithms and data structures for real-time ray tracing. This includes mechanisms to trade-off visual quality for interactivity and to add animation capabilities to real-time ray tracing. He has published more than 20 papers on parallel rendering and was involved in a course on parallel rendering at Siggraph '98.

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Philipp Slusallek is full professor at the computer graphics lab of Saarland University. From 1998 to 1999 he was visiting assistant professor at the Stanford University graphics lab. He received a Diploma in physics from the University of Tübingen, Germany in 1990 and a PhD in computer science from the University of Erlangen, Germany in 1995. He was responsible for the design of a commercial 2D/3D CAD package and has been leading the Vision project, a large object-oriented and physically-based rendering system. His current research activities focus on interactive ray-tracing on off-the-shelf computers and on designing a hardware architecture for real-time ray-tracing. Other research topics include the design of a network-aware multi-media infrastructure, consistent illumination in virtual environments, physically-based and realistic image synthesis, and object-oriented software design.

Time-line and Table of Contents

1:30 – 1:45 Introduction and Overview
Philipp Slusallek, Saarland University

Notes: Introduction to Interactive Ray-Tracing
Slides: Introduction to Interactive Ray-Tracing

1:50 – 2:30 Parallel Interactive Ray-Tracing
Steven Parker, University of Utah

Slides: Parallel Interactive Ray-Tracing

2:30 – 3:00 Interactive Ray-Tracing on PCs
Philipp Slusallek, Saarland University

Notes: Interactive Ray-Tracing on PCs
Slides: Interactive Ray-Tracing on PCs
Paper: Interactive Rendering with Coherent Ray-Tracing

3:00 – 3:15 Break

3:15 – 3:30 Distributed Ray-Tracing of Massive Model
Philipp Slusallek, Saarland University

Slides: Distributed Ray-Tracing of Massive Model
Paper: Interactive Distributed Ray-Tracing of Highly Complex Models

3:30 – 4:00 Point Reprojection and Dynamic Scenes
Erik Reinhard, University of Utah

Notes: Point Reprojection and Dynamic Scenes
Slides: Point Reprojection and Dynamic Scenes

4:00 – 4:20 Hardware Architectures for Ray-Tracing of Volume Data
Hanspeter Pfister, MERL

Notes: Hardware Architectures for Ray-Tracing of Volume Data
Paper: Architectures For Real-Time Volume Rendering
Paper: The VolumePro Real-Time Ray-Casting System

4:20 – 4:40 SHARP Ray-Tracing Architecture
Tim Purcell, Stanford University

Slides: SHARP Ray-Tracing Architecture

4:40 – 5:00 Discussion
All speakers and participants